

ART. XV.—*Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum*; by J. L. WORTMAN.

[Continued from vol. xi, p. 450.]

Family Viverravidæ.

Miacidæ Cope (in part), Tertiary Vertebrata, 1884; *Miacidæ* Scott, Jour. Acad. Nat. Sci., Phila., 1886, vol. ix, p. 169; *Viverravidæ* Wortman and Matthew, Bull. Amer. Mus. Nat. Hist., 1899, p. 136.

A FAMILY of small or medium-sized Carnassidents ancestral to the viverrines, ranging in time, as far as at present known, from the Torrejon to the Bridger Eocene, having pentadactyle limbs with ununited scaphoid, lunar, and centrale of the carpus, a civet-like perforation of the transverse process of the atlas for the passage of the vertebral artery, a well-developed anterior basal cusp upon the superior sectorial, no antero-posterior femoral curvature and no postero-internal cingular cusp upon the superior molars. Blades of the superior sectorial separated by a deep slit-like notch, and molar formula either $\frac{3}{3}$ as in the primitive Canidæ, or $\frac{2}{2}$ as in the Viverridæ.

In defining the foregoing family, it is necessary to distinguish it from the contemporary Canidæ on the one hand and its successors, the Viverridæ, on the other. As regards the former, while in all probability they have been derived from a common source, yet they have departed sufficiently in the direction of their subsequent and final development to be recognizable. There are two characters that appear to be entirely distinctive, one of which relates to the atlas and the other to the presence or absence of an anterior basal cusp on the superior sectorial; associated with these is the lack of curvature of the femur and no disposition whatever towards the formation of a postero-internal cingular cusp on the superior molars,—features which have characterized all lines of Canidæ in some stage of their development. From the Viverridæ, they can be distinguished not by any essential characters of fundamental importance, but only by the possession of such primitive and archaic features as we should reasonably expect to find in the ancestors of the modern viverrines. The more important of these relate to the separate condition of the scaphoid, lunar, and centrale of the carpus; the presence of a third trochanter on the femur; the large size and internal position of the lesser trochanter; the slight grooving of the astragalus, and the large size of the deltoid crest of the humerus. To this may be added the greatly inflated and modernized condition of the otic bulla in the living Viverridæ.

From the Mustelidæ, as far as at present known, the Viver-

ravidæ are distinguished not only by the possession of the primitive characters above enumerated, but by two very trenchant dental peculiarities which the mustelines exhibit, viz.: the great antero-posterior enlargement of the internal portions of the crowns of the superior molars, and the absence of the deep slit-like notch separating the two blades of the superior sectorial. These, together with the absence of the anterior basal cusp on the superior sectorial, the great breadth of the base of the skull, the small rugged bulla, and long bony spout-like meatus, constitute the real distinguishing features by which the Mustelidæ may be separated from the Viverridæ. The skeletal characters are otherwise much alike in the two families, the manner of perforation of the transverse process of the atlas being variable in the mustelines.

With reference to the Felidæ, it may be said that our knowledge is not so perfect regarding their origin and Eocene representatives as it is with respect to other living families, so that it is well nigh impossible to make a satisfactory comparison. If the Palæonictidæ are the forerunners of the felines, which seems so exceedingly probable, then the two groups belong to different phyla and may be distinguished by the structure of the superior molars. In the Palæonictidæ, it is the posterior part of the crown of the first superior molar which is elongate; whereas in the Viverravidæ, it is always the anterior part of the crown which is the longer.

Viverravus Marsh.

Viverra, a civet cat; and *avus*, a grandfather. This Journal, August, 1872; *Didymictis* Cope, Tertiary Vertebrata, 1884; *Viverravus* Wortman and Matthew, Bull. Amer. Mus. Nat. Hist., 1899, p. 136.

A group of small or medium-sized civet-like Carnivores, with a number of species distributed throughout the Eocene from the Torrejon to the Bridger inclusive. They are characterized by having the dental formula I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pm. $\frac{4}{4}$, M. $\frac{2}{2}$, of which the two superior molars of the dentition have broad tubercular crowns, with great transverse extension of the anterior border, the two external cusps being unequal and placed well inwards from the external margin of the crown; the second inferior molar, tubercular or becoming so, and much smaller than the first; the inferior sectorial having a high trigon, with oblique principal shear, a well-developed posterior shear, and a relatively large, more or less basin-shaped heel; and premolars having posterior accessory cusps.

In his original description of this genus, Professor Marsh says: "A much smaller Carnivore, about the size of the mink, is represented in our collections by two lower jaws with teeth, and a sectorial upper molar of one individual and portions

apparently of several others. The lower jaws in this genus are long, slender and compressed; the last two lower molars are tubercular. Both have the posterior part of the crown quite low and the anterior half elevated and composed of three angular cusps. The four teeth anterior to these are much compressed. The upper flesh tooth closely resembles that in some of the Viverridæ and the genus should probably be referred to that group."* The species thus far referable to this genus are numerous, of which one, *V. haydenianus*, from the Torrejon; four, *V. leptomytus*, *protenus*, *massefericus*, and *curtidens*, from the Wasatch; and two, *V. gracilis* (*dawkinsianus*) and *altidens*, from the Wind River beds, have been described by Cope. It will thus be seen that the genus has a very great vertical range, greater, in fact, than any known contemporary group of mammals throughout the whole Eocene. With the close of the Bridger epoch, according to our present knowledge, the genus disappeared from this country, since no remains of it have as yet been found either in the Uinta, White River, or John Day deposits.† It is possible, however, that the group may have continued to exist to a much later date on this continent, and that they retreated to the southward along with the tropical fauna which disappeared from Wyoming at the close of the Eocene. It is possible, therefore, that their remains will yet be found in the Miocene of the South, but this, of course, is merely conjectural.

Viverravus gracilis Marsh.

Didymictis dawkinsianus Cope, Tertiary Vertebrata, 1884, p. 310.

The type, figures 18, 19, consists, as Professor Marsh has stated, of parts of both mandibular rami and a superior sectorial, but there are at least twenty individuals of the species represented in the collection by various fragments. Of the type the right ramus is the more perfect of the two, and carries the third and fourth premolars and the first and second molars. The alveoli for the first and second premolars, together with that for the root of the canine, are represented. All the premolars are two-rooted, even the first, which among the Carnivora is very generally a single-rooted tooth. The third and fourth premolars have high pointed crowns, with anterior and posterior basal cusps, together with a distinct and trenchant accessory cusp. The sectorial has the trigon much elevated

* Loc. cit., p. 7, of separata.

† A possible exception to this statement may be found in the imperfectly known genus *Bunaelurus* of Cope, from the White River Oligocene of Colorado. When more fully known, it will not be at all surprising to find that this genus is a direct descendant of *Viverravus*.

and of greater antero-posterior length than the heel; the anterior and internal cusps are equal in height, but the external was evidently much higher; it is somewhat damaged and does not display its full length. The principal shear is oblique, and there is a posterior shear which bites against the anterior edge of the first molar. The heel is relatively short, wide, and basin-shaped; the external part of the basin is the thicker and more elevated. The second molar is much smaller than the first, but displays practically the same structure; the trigon, however, is much less elevated, and the shears are imperfect. The external and internal cusps are of equal size and height, but the anterior is much smaller and lower. The heel is relatively longer than in the first molar, being obtusely pointed behind, where it is terminated by a low but distinct cusp; from this cusp a low ridge is continued forwards and inwards to enclose the inner



FIGURE 18.—Right lower jaw of *Viverravus gracilis* Marsh; outside view; natural size. (Type.)

FIGURE 19.—Superior sectorial of same; outside and inside views; natural size. (Type.)

FIGURE 20.—Superior sectorial of *Viverricula* sp.; natural size.

part of the basin. Externally there is a stronger cusp situated in advance and to the outer side of the last mentioned cusp, which furnishes the external boundary of the basin.

The superior sectorial displays the typical laniary structure of the more highly-developed Carnassidents; it is composed of a pair of external cusps, laterally flattened and elongated in such a manner as to form a pair of very effective shearing blades. Of these, the anterior is the larger and more elevated, being separated from the posterior by a deep vertical notch, which appears as a narrow slit upon the lingual surface. At the antero-external angle of the larger cusp is seen a lower, but very distinct, anterior basal tubercle. Internal and opposite to the anterior edge of the main external blade is placed a relatively large, pointed internal cusp of about the same proportions of that of the Genet. In fact, the whole dentition, as far as known, is strikingly like that of this living species.

In his description of *V. dawkinsianus*, Professor Cope states that the first premolar of the inferior series is a single-rooted tooth. If this is true (which I am inclined to doubt), the two

species are distinct and we have the anomalous condition of the latest known species of the genus being less specialized in this particular than its immediate predecessor. The species is distinguished from all the others by its small size and the short broad heel of the lower sectorial. The principal measurements of the type are as follows:

Length of inferior molars and premolars	28· mm
Length of inferior molars	9·5
Length of sectorial	5·2
Transverse diameter of sectorial	3·4
Antero-posterior diameter of superior sectorial,	7·
Transverse diameter of superior sectorial	3·5

The type specimen was found at Grizzly Buttes, by G. G. Lobdell; other specimens were obtained at various levels from the upper to the lower part of the horizon.

Viverravus minutus sp. nov.

This species is represented in the collection by remains of at least six individuals, of which the lower jaws alone, in varying degrees of completeness, are preserved. That which is here

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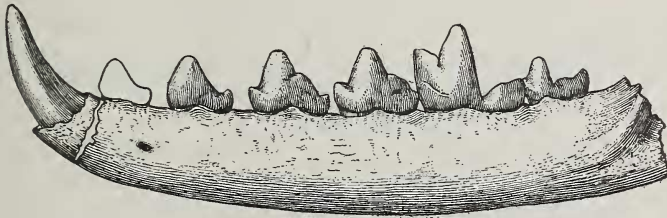


FIGURE 21.—Left lower jaw of *Viverravus minutus* Wortman; outside view; three times natural size. (Type.)

selected as the principal type, figure 21, is a left ramus carrying the molars and the three posterior premolars in good preservation. The specimen in question is broken just posterior to the base of the coronoid and also in front in the region of the symphysis, but it includes the base of the canine alveolus as well as that for the first premolar. The crowns of the molars are somewhat worn, so as not to display very clearly the character of the cusps of the heels. On this account, I associate with it another specimen as a cotype, also a left mandibular ramus of the left side, in which the heels of these teeth are more perfectly preserved. A third fragment of a jaw carries the canine in perfect condition.

The character of the species, as exhibited by these three specimens, may be stated as follows: It is considerably smaller than *V. gracilis*; the first premolar is two-rooted; the third and fourth premolars have anterior and posterior basal cusps and posterior accessory cusps which are absent on the second; the heel of the sectorial is proportionally narrower, and not quite so distinctly basin-shaped, as in *V. gracilis*. The last molar has a distinctly narrower, more trenchant heel and does not exhibit the two cusps seen in *V. gracilis*. The canine is long, slender, and considerably recurved. The remains indicate an animal of the size of the common weasel, the slender jaws and sharp cutting teeth giving evidence of a very highly carnivorous habit.

Length of inferior molars and premolars	21· mm
Length of inferior molars	7·
Length of first molar	4·5
Width of first molar	2·5
Depth of jaw at interior sectorial	4·5

The principal type specimen was found on Dry Creek, Bridger Basin, by Messrs. Lamothe and Chew, although other specimens are from Grizzly Buttes.

Oödetes herpestoides gen. et sp. nov.

Oön, an egg; and *detes*, a biter, in allusion to the habits of the Ichneumon.

A genus of small viverrine-like animals, having the dental formula I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pm. $\frac{4}{4}$, M. $\frac{3}{3}$, with trigon of inferior molars high, the cusps sub-equal, and the principal inferior shear high and very oblique; inferior molars with trenchant or slightly basin-shaped heels; transversely extended superior molars, with tubercular crowns; anterior and posterior external angles of first molar about equally extended, and antero-external angle of second more extended than posterior; a superior sectorial, with sharp blade-like principal cusps, and premolars without posterior accessory cusps.

The remains upon which this genus and species are founded consist of the larger part of the skeleton of one individual, considerably broken, but at the same time with nearly all the characteristic portions represented. I associate with this type two other individuals, one of which is represented by a left lower jaw, broken away at the base of the coronoid, but containing all the teeth, with the exception of the incisors, in a state of good preservation; the third specimen is the posterior portion of a left mandibular ramus of an immature individual, in which the fourth premolar was just coming into position.

Dentition.—With the exception of a single isolated tooth which apparently belongs to the upper series, the incisors are not preserved in any of the three specimens, but the bases of the alveoli for those of the lower jaw can be indistinctly made out. They were three in number and arranged apparently as in the *Paradoxures*, without having the second one pushed back out of line, as is frequently found in the *Canidæ* and some *Viverridæ*. The canine, figure 22, is relatively large, high, pointed, and recurved; there is a faint vertical external groove, and a broader shallow one upon the internal face of the crown; on the posterior and external surface is an extensive worn area, where the tooth impinged upon its fellow of the upper series.

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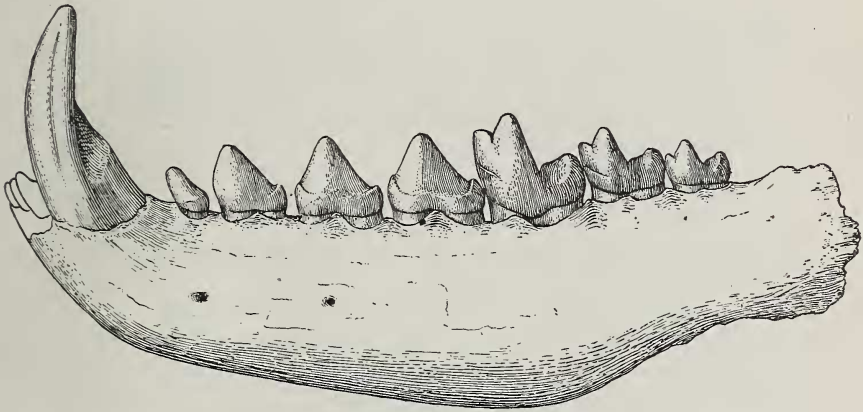


FIGURE 22 —Left lower jaw of *Oodectes herpestoides* Wortman; outside view; three times natural size. (Cotype.)

The premolars are four in number, with rather short, stout, thick crowns, having more or less of a tendency towards the development of strong internal cingula and cusps as seen both in the *Paradoxures* and *Herpestinæ*. The first is small, single-rooted, with an obtusely-pointed crown directed well forwards like the corresponding tooth in *Herpestes griseus*, and separated from the canine by a short interval. The second is abruptly larger, two-rooted, and has a small, indistinct posterior basal cusp. The third and fourth are still larger; their crowns are relatively thick, with obtuse points and inconspicuous anterior and posterior basal cusps; there are no posterior accessory cusps present, except a slight indication of one in the last premolar, as in *Herpestes*, to which the series of teeth, including the canine, bears a very striking resemblance.

The molars show many peculiarities for a Carnivore, and at first glance might indeed be readily mistaken for an Insecti-

vore; but a careful examination clearly reveals their carnivorous character. As is usual among the Carnassidents, the first molar is the largest of the series, which decreases in size posteriorly. Where the full number is present, it is a very general rule that the first greatly exceeds the second in size; but in the present case the decrease is much more gradual. The crowns have the anterior part much elevated and divided

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FIGURE 23.—Lower molars of *Oödetes herpestoides* Wortman; inside view; three times natural size. (Cotype.)

into the three usual cusps. Instead, however, of the external one being much larger and higher than the other two, they are more nearly equal (figure 23). They are placed at the points of a triangle whose sides are sub-equal, the shortest side, or base, being directed inwards and a little forwards. Between the outer and anterior cusps a short more

or less imperfect shear is developed, and a posterior shear is also present between the outer and inner cusps. The heel is composed of a central fore and aft secant ridge, on the inner side of which the border is slightly raised, thus giving the first step in the formation of the basin-shaped talon. The succeeding teeth are alike in structure, with the exception that the principal shear is proportionately less developed on account of the reduction in size of the anterior cusp of the trigon.

Of the superior dentition, figure 24, the single incisor, if it is correctly referred to this category, has a rather narrow, pointed crown, somewhat flattened upon its posterior surface, and corresponds most nearly with the second. The canine resembles that of the lower jaw, showing about an equal degree of stoutness and curvature. The first premolar is not preserved in any of the specimens. The second has an obtusely-pointed crown, with a small posterior basal cusp and an indistinct cingulum upon the inner margin of its base. The third is thicker, somewhat triangular in cross-section, with a more pronounced posterior basal cusp and a stronger internal cingulum. In many of the viverrines, more particularly the Herpestine and Paradoxurine sections, the third premolar has a tendency to develop an internal cusp, and the formation of the internal cingulum may be regarded as the initial stage in this process.

At first sight it would appear that the fourth superior premolar is of a too highly developed sectorial character to correspond with that of the lower jaw; but, curious as this may seem, there can be no possible doubt of the association. This tooth, however, betrays its primitive character in the large size

of its antero-external cusp, which is relatively high and conical, with its posterior portion little drawn out into a cutting surface. The posterior cusp is sharp and blade-like, but proportionally small. The two are separated by the usual vertical fissure. There is a distinct anterior basal cusp, which has an unusually external position. The presence of this cusp is a very constant feature of the viverrines, and its external position recalls the Herpestine section of the family. The internal cusp is of only moderate proportions and is placed well forwards, as in the civets in general.

The first molar is symmetrical in respect to the extension of the external angles; they are both equally extended and the two sub-equal external cusps are placed well inwards from the

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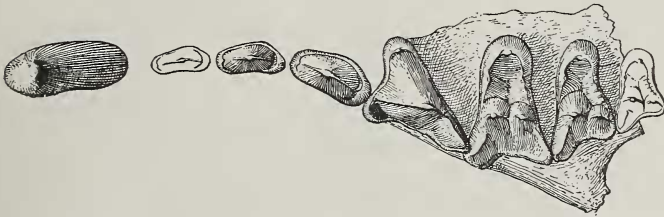


FIGURE 24.—Right upper jaw of *Oödictes herpestoides* Wortman; crown view; three times natural size. (Type.)

crown margin. The internal cusp is large and lunate, and there is a well-developed anterior and a very faint posterior intermediate cusp. The second molar has the antero-external angle well extended, but the posterior is short; with the exception of this difference its structure is very like that of the first. The third molar is not preserved, but the alveoli indicate not only its existence but its goodly size as well.

Vertebrae.—While the vertebral column is by no means complete, yet a number of the vertebræ are preserved and serve to give some idea of this part of the skeleton. A portion of the atlas, figure 25, shows that the perforations for the vertebral artery are the same as those in the civets. The body of the axis is rather long, sharply keeled below, and there is a well-developed peg-like odontoid process. The bodies of the remaining cervicals are short, depressed, and keeled; they are smaller in proportion to the size of the lumbers than in any of the living civets. The lumbers increase in size

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FIGURE 25.—Portion of atlas of *Oödictes herpestoides* Wortman; top view; three halves natural size. (Type.)

progressively backwards, showing elongated inferiorly keeled centra. The third lumbar, figure 26, has a spine of moderate

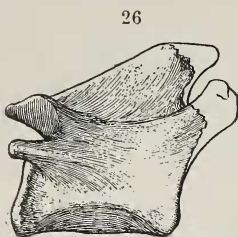


FIGURE 26.—Third lumbar vertebra of *Oodectes herpestoides* Wortman; side view; three halves natural size. (Type.)

height, and simple, cylindrical posterior, and hollow, half cylinder-like anterior zygapophyses, and distinct anapophyses and metapophyses. There is apparently no trace of the double tongue and groove pattern of certain of the contemporary Creodonts. The sacrum is composed of three ankylosed vertebrae, and there was a long and powerful tail.

Fore limb.—The scapula is represented by the proximal end in a damaged condition. The glenoid cavity is elliptical and cup-shaped; the neck is very short, the unusually heavy spine rises close to the glenoid border, as in the Binturong, and there was a prominent metacromion present.

The humerus, figure 27, is complete, but considerably crushed laterally; it exhibits the following characters: The head is well rounded, pyriform, and overhangs the axis of the shaft posteriorly; the greater tuberosity is inconspicuous, and does not reach the level of the head; the deltoid crest is large and extends well down the shaft; the distal extremity is broad, with large supinator ridge and internal condyle, and there is an entepicondylar foramen.

In its proximal portion, the ulna, figure 29, exhibits some peculiarities of structure to which that of the Binturong makes a very decided approach. The chief peculiarity is seen in the upward curvature of the under surface of the olecranon and its great lateral breadth. Upon its inner or radial side, it is produced in such a way as to form a broad shelf-like projection, as in the Binturong; it is relatively short and thick as in this latter species, in marked contrast with its elongated form in many of the contemporary Creodonts. The posterior wall of the greater sigmoid cavity has comparatively little elevation, giving to the cavity a shallow appearance, but the anterior boundary or coronoid process is prominent and well extended upon its radial side. Just in front of this latter process is seen the deep muscular impression for the attachment of the tendon of the anterior brachial muscle. The shaft is considerably flattened from side to side and traversed by broad shallow longitudinal grooves, which continue to the distal end. In the lower fourth of its extent, the shaft becomes sharply triangular in cross-section by reason of the development of a sharp ridge from the more or less rounded internal surface. This

ridge is very highly developed in the Binturong and less so in *Herpestes*. The distal end is not preserved.

The radius, figure 28, as compared with the ulna in size, holds about the same relationship as that seen in the civets in general. The head is cup-shaped and has an imperfectly circular outline, indicating thereby complete power of rotation.

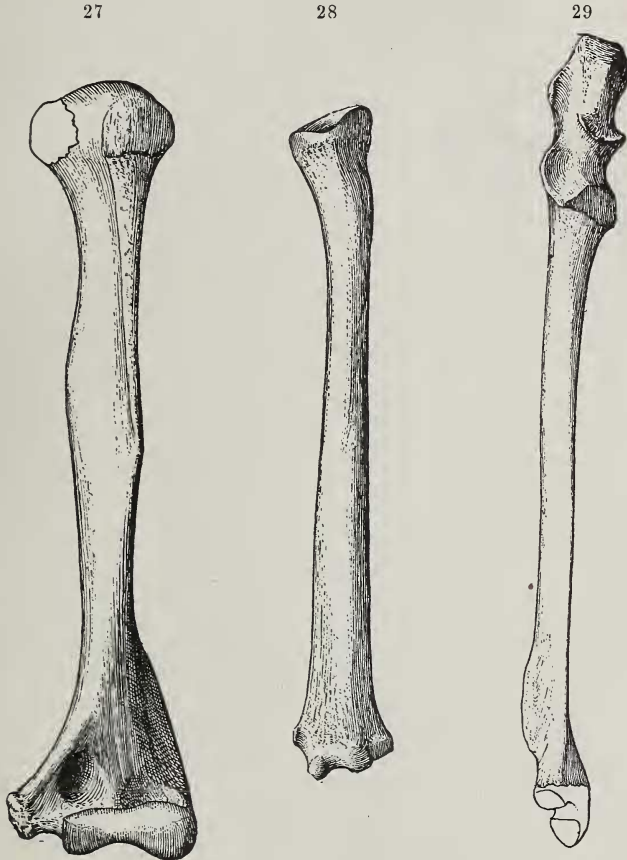


FIGURE 27.—Humerus of *Oodectes herpestoides* Wortman; front view.

FIGURE 28.—Radius of same species; front view.

FIGURE 29.—Ulna of same species; front view.

All figures are three halves natural size. (Type.)

The shaft is slightly curved, somewhat compressed, and distinctly trihedral in its lower fourth. The distal end is provided with a well-developed styloid, deep tendinal grooves, and a well-excavated articular surface for the scaphoid and lunar.

The manus, figure 30, is sufficiently preserved to furnish a fair idea of its organization. All the carpal bones are present with the exception of the lunar, magnum, and pisiform. The scaphoid, centrale, trapezium, and trapezoid, with the proximal portions of the first three metacarpals attached, were found in the position shown in the accompanying figure, and there is reason to believe that the positions of the bones are substantially correct. The scaphoid is relatively large, and is articu-

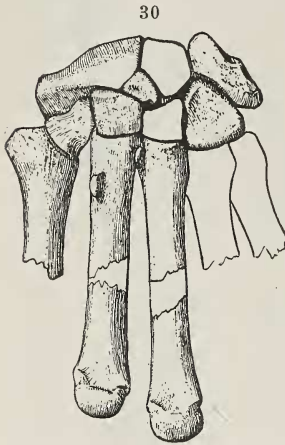


FIGURE 30.—Left manus of *Oödestes herpestoides* Wortman; two and one-fourth times natural size. (Type.)

lated distally with the trapezium, trapezoid, and centrale. The trapezium is of moderate size and supports the pollex in the usual way, which is not to any very great degree opposable, if at all. The trapezoid is rather large, of an imperfectly triangular form, and supports the second metacarpal. The centrale may be said to have an outline intermediate between a quadrate and triangular pattern; it rests unequally upon trapezoid and magnum, and lies under the junction of the scaphoid and lunar. The unciform resembles that of the modern civets, and presents a lateral facet for articulation with the lunar. The cuneiform is flattened from above downwards, and articulated with the unciform in quite the usual way.

Of the metacarpals, that of the pollex is the heaviest, the second and third being more slender, with rather narrow proximal extremities. On the upper portion of the shaft of the second is seen a prominent tuberosity, and a less conspicuous one upon the third near the proximal extremity. These bony protuberances, if normal, probably served for the attachment of the long and short carpal extensors, since, in position, they correspond nearly to the insertion of these muscles. The length of the metapodials cannot be ascertained, but they were presumably short. Their distal ends are hemispherical and keeled like those of the modern civets. Some fragments of the proximal row of phalanges are preserved, and these are again like those of *Herpestes* and the Binturong. One perfect phalanx, figure 31, belonging probably to the second row of the fore foot, is long and slender, notably more so than in the Binturong, wherein they are longer than usual in the Viveridæ. No ungual phalanges are known.

[To be continued.]